# Steering magnets and BPM's in the high energy transfer line.

R. K. Koul
Argonne National Laboratory

This note contains the details concerning the steering magnets and the beam position monitors needed in the high energy transfer line. The computer code, written in "C" and used for the ray tracing of the positron particles was written locally with the express purpose of handling this problem. However, the accuracy of the code was tested by calculating the twiss parameters of the high energy transfer line and comparing that against the twiss parameters as calculated by the computer code "COMFORT".

The high energy transfer line is about 65.5015 m long and the details of the lattice parameters are given in Crosbie. [1]

The calculation was carried out by giving a certain fixed amount of kick to the particles at high $\beta$ values of the twiss parameters. This kick was then traced down the transfer line and a BPM was placed at the position where the amplitude of the displacement was found maximum for a given Kick. The same procedure was then carried out down the transfer line by kicking the beam at the next high $\beta$ region. This procedure was carried out in both the horizontal and the vertical plane. From the calculations it was concluded that we need five steering dipoles for steering the beam in the horizontal direction and five steering dipoles for steering the beam in th vertical direction. The number of BPM's needed in each plane is six. The position of the BPM's alternates with the steering magnets as shown in table1 and in figures 1 and 2. The maximum $B\ell$ for the steering dipoles turns out to be 0.07 tesla-meter. Choosing the length of the steering magnet to be about 10 cm we obtain the maximum dipole field strength needed for the steering magnets as about 7 k-Gauss. The details of the resulting parameters are given in the table1.

## 1. References

1. E. A. Crosbie, Revised lattice for the APS Storage Ring LS-142, Aug. 1989..

Table 1: BTOS PARAMETERS
(450 MeV. $Bp = 1.503$T-meter. -Positive $K_1$ means horizontal defocussing.)
Input Twiss Parameters:$\alpha_x = 2.7522, \beta_x = 15.3506, \alpha_y = -0.5986, \beta_y = 2.9160$
Output Twiss Parameters:$\alpha_x = -0.1313, \beta_x = 14.4105, \alpha_y = -0.186, \beta_y = 10.346$

| Element | Length | $\theta$ or Magnet Strength $K_1 = B'/B\rho[m]^{-2}, \rho[m]$ | Theta1 | Theta2 |
|---|---|---|---|---|
| *DRIFT*:DB1 | 0.25 | | | |
| *SBEND*:S2B | 1.0 | -.028224 | -.000956 | -.024268 |
| *DRIFT*:DB2 | 0.2 | | | |
| *SBEND*:S14B | 1.0 | -.035291 | -.000956 | -.031335 |
| *DRIFT*:DB3 | 0.2 | | | |
| *SBEND*:S30B | 1.0 | -.042314 | -.021157 | -.021157 |
| *DRIFT*:D11 | 1.783 | | | |
| $BPM_y$ | | | | |
| *DRIFT*:D11 | 0.2 | | | |
| QUAD:Q11 | 0.6 | 0.590132 | | |
| *DRIFT*:D120 | 0.2 | | | |
| $Steering_y$ | 0.10 | 0.28 | | |
| *DRIFT*:D12 | 2.8 | | | |
| $BPM_x$ | | | | |
| *DRIFT*:DB2 | 0.2 | | | |
| QUAD:Q12 | 0.6 | -.594074 | | |
| *DRIFT*:DB2 | 0.2 | | | |
| $Steering_x$ | 0.10 | 0.35 | | |
| *DRIFT*:D13 | 5.1 | | | |
| $BPM_y$ | | | | |
| *DRIFT*:DB2 | 0.2 | | | |
| QUAD:Q13 | 0.6 | .427 | | |
| *DRIFT*:DB2 | 0.2 | | | |
| $Steering_y$ | 0.10 | 0.27 | | |
| *DRIFT*:D14 | 5.1 | | | |
| $BPM_x$ | | | | |
| *DRIFT*:DB2 | 0.2 | | | |
| QUAD:Q14 | 0.6 | -.576377 | | |
| *DRIFT*:DB2 | 0.2 | | | |
| $Steering_x$ | 0.10 | 0.42 | | |
| *DRIFT*:D15 | 2.8 | | | |
| $BPM_y$ | | | | |
| *DRIFT*:DB2 | 0.2 | | | |
| QUAD:Q15 | 0.6 | 0.319337 | | |
| *DRIFT*:DB2 | 0.2 | | | |
| $Steering_y$ | 0.10 | 0.23 | | |
| *DRIFT*:D16 | 0.6 | | | |
| *SBEND*:B11 | 1.6 | .0775508 | .0387754 | .0387754 |
| *DRIFT*:DM12 | 0.3 | | | |
| *SBEND*:B12 | 1.6 | .0775508 | .0387754 | .0387754 |
| *DRIFT*:D21 | 3.0 | | | |
| $BPM_x$ | | | | |
| *DRIFT*:DB2 | 0.2 | | | |
| QUAD:Q21 | 0.6 | -.418260 | | |
| *DRIFT*:DB2 | 0.2 | | | |
| $Steering_x$ | 0.10 | 0.37 | | |
| *DRIFT*:D22 | 2.3 | | | |
| QUAD:Q22 | 0.6 | .216596 | | |
| *DRIFT*:D23 | 4.8 | | | |
| $BPM_y$ | | | | |
| *DRIFT*:DB2 | 0.2 | | | |
| QUAD:Q23 | 0.6 | .204265 | | |
| *DRIFT*:DB2 | 0.2 | | | |
| $Steering_y$ | 0.10 | 0.32 | | |
| *DRIFT*:D24 | 2.6 | | | |
| $Steering_x$ | 0.1 | 0.7 | | |
| *DRIFT*:D24 | 0.2 | | | |
| QUAD:Q24 | 0.6 | -.545209 | | |
| *DRIFT*:DB2 | 0.2 | | | |
| $BPM_x$ | | | | |
| *DRIFT*:D25 | 0.3711 | | | |
| *SBEND*:B21 | 1.6 | .0775508 | .0387754 | .0387754 |
| *DRIFT*:DM34 | 0.3 | | | |
| *SBEND*:B22 | 1.6 | .0775508 | .0387754 | .0387754 |
| *DRIFT*:D31 | 0.9 | | | |
| $BPM_y$ | | | | |
| *DRIFT*:DB2 | 0.2 | | | |
| QUAD:Q31 | 0.6 | .563554 | | |
| *DRIFT*:DB2 | 0.2 | | | |
| $Steering_y$ | 0.10 | 0.42 | | |
| *DRIFT*:D32 | 0.9 | | | |
| $BPM_x$ | | | | |
| *DRIFT*:DB2 | 0.2 | | | |
| QUAD:Q32 | 0.6 | -.739211 | | |
| *DRIFT*:DB2 | 0.2 | | | |
| $Steering_x$ | 0.10 | 0.42 | | |
| *DRIFT*:D33 | 2.1 | | | |
| QUAD:Q33 | 0.6 | .168881 | | |
| *DRIFT*:DB2 | 0.2 | | | |
| $BPM_y$ | | | | |
| *DRIFT*:D34 | 3.6974 | | | |
| $BPM_x$ | | | | |
| *DRIFT*:DB2 | 0.2 | | | |
| *SBEND*:S30R | 1.0 | .042314 | .021157 | .021157 |
| *DRIFT*:DR3 | 0.2 | | | |
| *SBEND*:S14R | 1.0 | .035291 | .035291 | .000 |
| *DRIFT*:DR2 | 0.2 | | | |
| *SBEND*:S2R | 1.0 | .028224 | .028224 | .000 |

# VERTICAL MOTION

| ≡ BPM
| ≡ Steering MAGNET

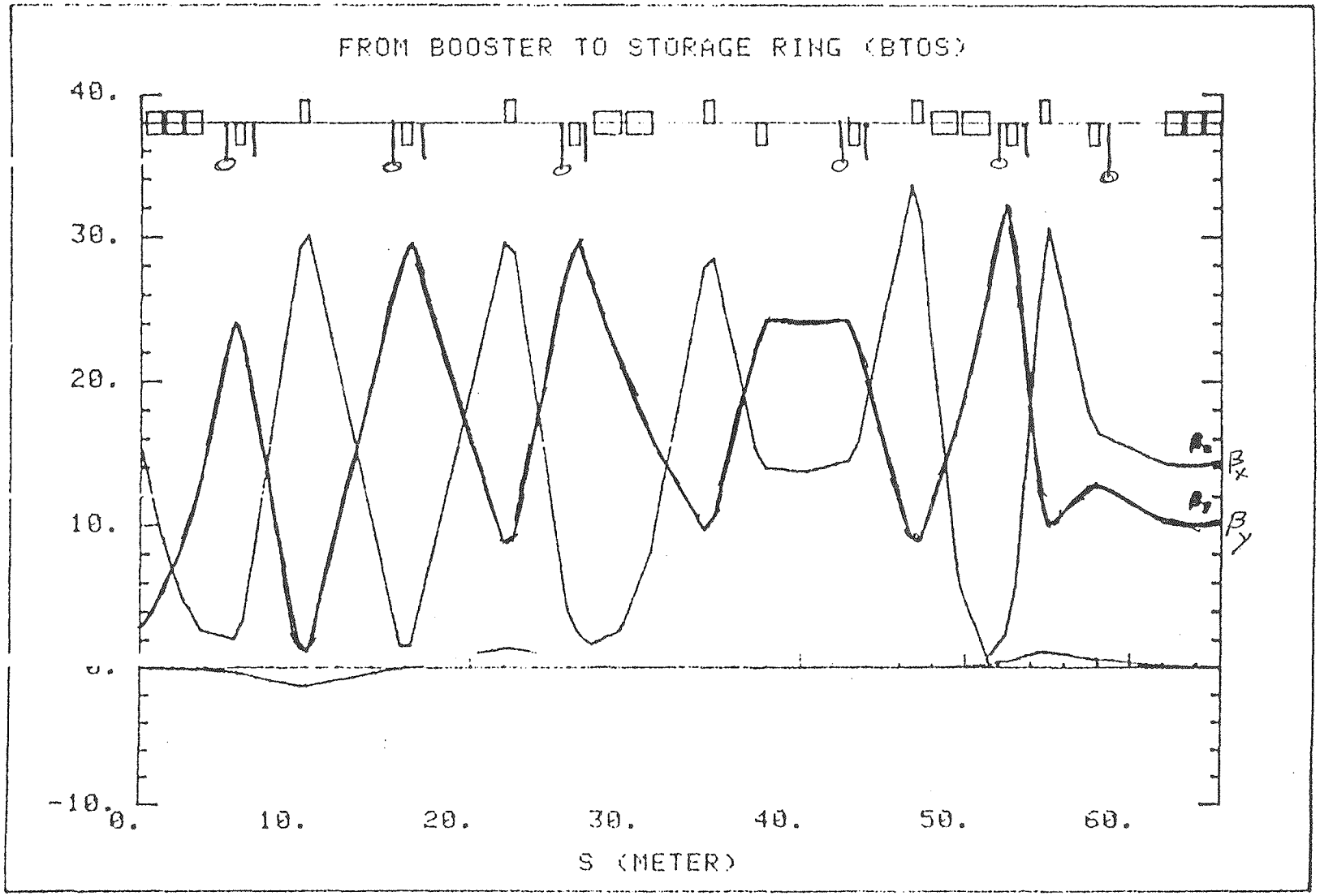


Fig. 1

HORIZONTAL DIRECTION

= BPM

| = steering magnet

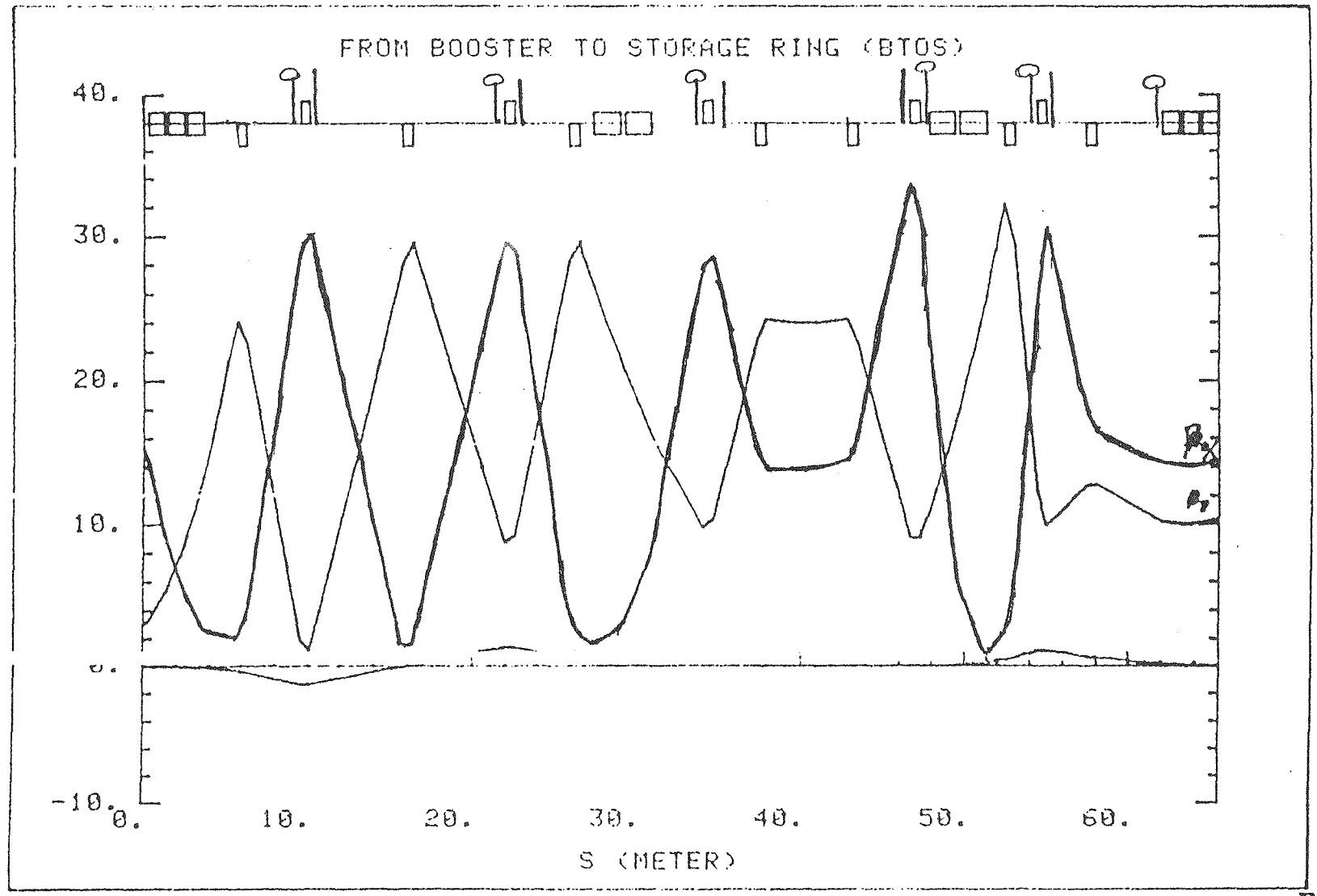


Fig 2.

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